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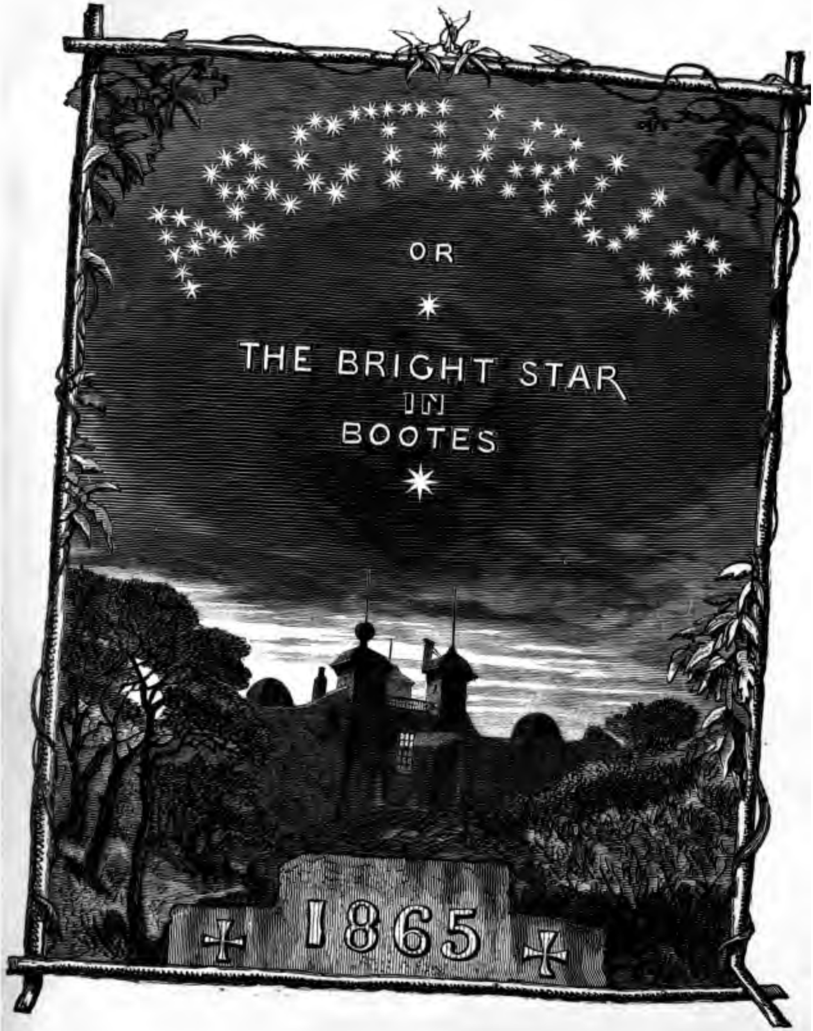
ARCTURUS
OR
THE BRIGHT STAR
IN
BOOTES

MRS. WILDFIRE EXPLAINS TO HARRY THE CAUSE OF DAY AND NIGHT, AND THE SEASONS.


ARCTURUS
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1865

ARCTURUS;

OR,

THE BRIGHT STAR IN BOOTES.

AN EASY GUIDE TO SCIENCE.

BY

MISS SEDGWICK,

AUTHORESS OF "PEARLS OF THOUGHT."

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1865.

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Introduction.

THE object of the following conversations is to tide the young scholar over the difficulties that beset his path in the pursuit of science. Many of these difficulties are imaginary; but they are not the less difficulties on that account. Easier to harpoon the whale that supplies the student with his midnight oil, than to grapple with the ghost that troubled Brutus; but progress works wonders. Thanks to the improvement in arts and sciences, ghosts are deprived of their terrors, their cold shades are secured, and all knowledge may be patented. No sooner is the student admitted behind the scenes, than difficulties melt into thin air, and he wonders how he could have been so slow in acquiring the knowledge he would not now exchange for all the wealth of the Indies. But one instance is worth many theories.

Master Tommy is already the plague of the family; his energies, if properly directed, might have thrown his earliest thoughts, and subsequent life, into quite a different channel. But there is not leisure to pursue this idea of what Tommy might have been; it would take us out of our way to dip deep into the metaphysics. He is surrounded by people who see nothing in his thirst for knowledge, but an incessant tendency to get into mischief. A shriek is heard! it comes from the nursery; that boy again! Tommy is discovered just completing an experiment he has been making on his sister's doll; he is curious to know what the doll is stuffed with, and instead of going scientifically to work, as a well-trained boy would have done, by opening a thread, which would have proved a vein of discovery, he seizes the first implement that comes to hand, with which he makes an incision, and finds to his confusion, that the doll is stuffed with bran! Tommy perceives his error; he has been tampering with what does not belong to him. Laying dolly hastily down, he begins to gather up a handful of the bran which continues to flow from the wound, with the intention of throwing it on the fire before that domestic tyrant, nurse, shall return. A new wonder seizes him: on transferring the bran from the carpet to the fire, a grand pyrotechnic display of green and yellow lights takes place; at first he is rather frightened; he then passes into a transition state, and becoming much elated he finishes up his work by putting the now dilapidated doll on the fire. It is at this moment that his sister enters the room to see the last of her doll's beautiful flaxen wig curling into the flames. It is from her the shriek proceeds that has brought nurse to the spot, alas! too late for the rescue; she is only in time to see the fender and fire irons reeking with the molten wax. Shall the culprit escape? On no account would nurse lose the opportunity of repeating her constant cry, that Master Tommy is the naughtiest, and wickedest boy she has ever met with. His mamma is appealed to, but she has delicate nervès, and protests her inability to manage such a boy. This is true enough. Nurse confidently hopes that when his papa returns some adequate punishment will be decided on. Whilst the storm is raging, there sits a lady who is not a member of the family, but only of "the persuasion;" she is embroidering in shaded wools a lamb with garnet bead eyes, and takes this opportunity of lecturing Tommy on the exceeding sinfulness of small sins. "Small sins, Ma'am," screams nurse, "I hope you do not mean to call it a small sin to take the beautiful wax doll, which Miss Rosa's godmamma gave her on her last birthday, and put it on the fire! Why it was only the other day," and then follows the history of another grievance of which nurse was herself the victim. The only thing to save him, she avers, will be to send him to a good school where he will be flogged every time he deserves it, this being the test of a good school.

In the meanwhile, the author of all this disturbance stands, not leaning on his sword, but against the "what not," looking as sulky as Ajax! A judicious word would have set all to rights, but there is no one to speak it. Tommy labours under a chronic sense of perpetual injustice; he knows he is not so bad as he is represented; he also knows that the lady lecturer is not so good as she wishes to be thought; but he scorns reprisals. Nurse has another aggravating word in store, peculiar to persons of small reasoning powers; she quotes as a model Master Harry Wildfire, the hero of these conversations, a young gentleman whose hair is always smooth, whilst Tommy's is generally rough; whose manners are irreproachable, whilst Tommy has no manners at all to speak of; who is presentable at all times, while Tommy, who is an excellent customer to tailors and hatters, is never fit to be seen. In the midst of these reproaches Tommy seals his lips with the wafers of discretion; he forbears to say what he might say in self-defence, to remind the assembled conclave that Harry has a mother who is devoted to him, that this excellent parent leaves him no time to be naughty, that whilst nurse accuses him of turning his sister's doll into "kitchen stuff," his more accomplished friend would add "with a small remainder of carbon, which passed up the chimney." Tommy sighs as he remembers how happy and how rational his friends are in their nutshell of a lodge; strange to say, when with them he is happy and rational too! 'tis a different atmosphere he breathes, and he yields to its influence; but he forbears to give expression to his thoughts; were he to do so there is one lady present who would go into hysterics;

while nurse, who knows on which side her bread is buttered, would declare him a wicked, ungrateful boy, and predict he would be the death of his dear mamma, always so indulgent. Should any little boy, who reads this history, be induced to say "that's me," we beg to assure him he is mistaken. Tommy, better known as Timothy Goodchild, Esquire, of Dunceaton Hall, in the County of ——— but we must avoid being too particular, is now a great man; stands six feet three inches high in his boots, lives much in the saddle, hunts every day in the season, keeps the pack, and, like the celebrated Bootes of the constellations, may be seen continually in the company of his dogs. His neighbour, Harry Wildfire, is a great practical philosopher, whose studies render him happy all the year round. Now and then he enjoys a day with the hounds, but hunting is his pastime, while with his friend it is a business, and a sorry one at times. Mr. Wildfire's riches are portable; he takes them with him whithersoever he goes; there's no packing, or unpacking required. Mr. Goodchild, on the contrary, finds himself often at a loss, especially in wet weather, when, for want of mental resources, he has many a dull hour.

Should this little treatise fall into his hands, it is earnestly hoped he will not betray his identity by any exclamation of surprise. The authoress feels confident he will bear her no ill will for seizing on his case, to point a moral; he has not turned out so wicked as nurse predicted; his faults were the "faults of circumstances, but his virtues are his own." His first care on recovering from his surprise at finding himself thus immortalized like another Bootes, will be to secure a copy of these Conversations on Astronomy for his son and heir, the future Squire of Dunceaton, which he will present, saying, "Here, my boy, is a book for you; make yourself master of its contents, and then you will be a wiser man than your father;" to which he will add, "Authors and authoresses did not give themselves the trouble to make learning easy in my young days;" and Timothy junior, who believes his father to be the wisest of men, as he knows him to be the most indulgent of parents, will receive the book with reverence and gratitude, retiring to some classic corner, from which he will emerge with regret, should he be summoned to attend any other duty or pleasure, ere the parental injunction is obeyed.

In case any of the "little good people" into whose hands this book may alight should be young ladies, it may interest them to know what became of the owner of the doll so cruelly sacrificed. As there is no danger of hurting her feelings we need not scruple to speak out. Rosalind Goodchild never liked science, and is no patroness of knowledge; if told the dimensions of the planets, or their distances, she would argue the point, like Mr. Midshipman Easy, and say, "Who ever went up there to measure them?"—thus throwing cold water on celestial phenomena. When about fourteen years of age, it was suggested to Rosalind that she should learn Italian. For the first time in her life she seemed to reflect. At the end of a few seconds she astonished her counsel by exclaiming, "Why should I? Caroline never learnt Italian, and she's got a husband!" The answer was conclusive, all thoughts of Italian had to be given up, and as years roll on, there is every probability that all thoughts of a husband will have to be given up, for whether it be that no one has yet been found sufficiently stupid to come up to the mark, or that the name has been thought too pretty to require changing, certain it is, that Rosalind Goodchild retains her patronymic to this day.

THE GIANT OF THE HARTZ MOUNTAINS.

CHAPTER I.

Harry and his Mamma—The Giant of the Hartz Mountains—Harry enquires what is Refraction?—Resolves to begin at the beginning, and become a Philosopher—Finds his Book on Astronomy too difficult—His Mamma undertakes to help him by making Astronomy easy—They begin with the Solar System.

M You had better shut your book, Harry; you will only strain your eyes by reading any more at present.

H Oh, mamma, it is still quite light. I can see perfectly well to read.

M It cannot be quite light, Harry, so long after sunset; you should accustom yourself to speak with more accuracy if you wish your words to be of value.

H Well, dear mamma, I did not mean to say it was quite broad daylight, only that *I* can see very well to *read*, and I want so much to finish this story.

M For whose good is it, Harry, that I ask you to lay aside your book?

H For mine, I suppose, mamma; you are afraid I shall be blind, and that you will have to lead me about; but I do not think there is any danger just yet.

M Oh, Harry, if you knew how many people there are now have to repent straining their eyes when young, and what sad privations they undergo in after years in consequence, you would not speak so lightly on so serious a subject.

H (Shuts his book with energy). There, mamma, I've done.

M You have had a long day's study I

think, you began with daylight, and end after sunset.

L Who told you I began so early?

M (Laughing). Oh, a little bird.

L I asked Robert to call me as soon as it was light; was there any harm in that?

M None whatever, my child; I am glad you found something to interest you.

L And improve me too, mamma; such wonders! I have been reading about the Giant of the Hartz Mountains, who frightens the simple people in Norway, and the traveller, who saw the giant, was astonished, until he found out who the giant was.

M Himself, I suppose.

L Oh, mamma! you have read the anecdote. I am always trying to tell you something new, but I believe you know everything already.

M Not quite; but I know the same cause must always produce the same result; that whether a shadow falls on a mountain or on a wall, it will be magnified in proportion to the distance of the object, the sun's position in the heavens, and the refraction of the atmosphere.

H That's it, mamma; that's the word I wanted to remember. Will you tell me what is refraction?

M Willingly, my dear, but had we not better begin at the beginning? You will require to know something about light, and the source of light, before you can understand about shadow.

H The sun you mean; but mamma, I want to know first of all what is a philosopher?

M One who loves wisdom, and seeks after knowledge, and goes to the fountain head to obtain it.

H Then I think I should like to be a philosopher, and have you for my fountain head.

M (Smiles). I did not ask you for so great a compliment, Harry; but the wisest of men has said, "get wisdom, get understanding;" and the greatest of our English poets, Shakespeare, has declared, that "truth is strange, stranger than fiction."

H I am sure of it; and if the strange things I have been reading about to-day are all true, I shall never care to read any more about shams, if that's what Shakespeare meant by fiction.

M Fiction means the exercise of the imagination, which rather carries us out of the world of realities.

H But what I want is reality. When I read a book that interests me, I always want to ask the writer if it is true?

M A very fair challenge for the author; I would not wonder if my little Harry turns out a philosopher; studying by daylight, chatting by twilight, and thinking when it is too dark for either.

H But I like chatting best, because you make it all so nice.

M I shall be very glad to help you whilst you remain a little boy; but remember there is no royal road to learning; there will be plenty of hard work, much that you will have to puzzle out for yourself, plenty to learn, and more than that, plenty to unlearn; sometimes our philosophers find themselves on a wrong tack, new discoveries upset the old theories, and so they have to begin over again.

K Oh, I shall not mind that, if I can only get the truth at last.

M Truth alone would occupy at least a hundred years of any one's life to come at, and human life does not usually go beyond three score years and ten, that is, seventy years.

K Then as life is so short, the sooner we begin the better. There is something I have been thinking about all day, I had a great mind to ask Robert, but I was afraid he would think me so very ignorant that I was ashamed.

M Speak, my child, we are all very ignorant; it is God alone who knows all things: not one of us can tell how the leaf grows on the tree; we only know that it is so, but God has vouchsafed us understanding that we may seek Him in His wonderful works; what is it so puzzles you?

H (Looks foolish). What I want to know, mamma, is this: when the sun goes down and we lose sight of him, where does he go to, and when he comes up again in the morning, where does he come from?

M You want to know something of astronomy in short?

H Yes, mamma; but you said astronomy was too difficult for me.

M I said your book on astronomy was too difficult for you; but I think if you would like to learn, I can find language sufficiently simple to make you understand the laws by which the universe is governed.

H Oh, mamma, how delightful!

M Yes, Harry, and you need not be ashamed of your ignorance; for I assure you there are many grown gentlemen whose education has been finished at our Universities, or to speak more correctly, is supposed to be finished, whose language is not more scientific than your own, and whose ignorance is as great; it has always seemed to me one of the strangest defects in our system of education, that astronomy, which so closely borders on religion, should be so utterly neglected; yet so it is.

H Another thought occurs to me.

M And what is that, my dear?

H I have been thinking how many little boys would like to be in my place; they might go on puzzling for ever over my foolish question and never make it out, and then, when they got the books, they might find them too difficult; and so the little Harries might grow up big Harries, and big dunces too, because they had no clever mamma to make it all plain to them.

M You are a kind generous boy to think of others; and, now you have given me an idea by which I may make my lessons of use to others as well as to you, suppose we follow up our conversations by writing them out when *the lamp comes*; after that we may correct the errors, if any should creep in; then put our papers into the printer's hands, when he will make a book of them, for the benefit of those little boys who are not present.

L What a bright idea.

M The lamp will have a great deal of duty to do this evening; I intend it shall serve me as an artificial sun, and illustrate my first lecture.

L But papa said the new lamp must not be moved after it had been put on the table.

M I do not think there will be any need to disobey the order.

L But, mamma, how can the lamp, which does not move, represent the sun, which is always moving?

M You have just reversed the state of the case; to move our beautiful drawing-room lamp is easy, though attended with danger unless great care be used, but to move the beautiful lamp in the heavens, which God has placed there to give us light, and heat, *would be impossible.*

H (Opens his eyes with astonishment). Impossible! Do you mean to say, mamma, that the sun, which I saw this morning rise from my own little window on the other side the house, and set just now on this side, never moves?

M That sun, which is the centre of our solar system, is stationary, which means, that it does not move.

H Oh, mama, it takes my breath away to think of it. I know you would not deceive your little Harry, but how difficult to understand; if all the other truths are as hard to believe as this, I am afraid I shall grow into a man, before I am able to learn them.

M Patience, Harry, the explanation is very simple, and if you do not thoroughly understand the cause of the phenomenon which you daily observe, before you renew your acquaintance with your brilliant friend to-morrow morning, I shall say my Harry is a duller boy than I took him to be. Now ring the bell.

MAGI WORSHIPPING THE SUN.

CHAPTER II.

Tea-table Chat—Harry's Impatience—Order—The Lamp does duty for the Sun, in the absence of that Luminary—Optical Illusions—What are they?—The Express Train—Whilst objects seem to fly past, the Moon keeps pace—Harry qualifies himself to become a Man of the World in the true sense, by learning something of the Laws by which it is governed—More and more interested in his Studies—The old Egyptians—The Zodiac—The Temple of the Sun—Aurora with her rosy fingers.

A servant enters bringing in the lamp.

H Now, mamma, you will explain all I wish to know.

M First of all we will have tea, otherwise we shall be liable to continual interruption.

H True, mamma, I had forgotten; but cannot we delay having tea?

M You must rein in your impatience, Harry; order was heaven's first law, it is thus—

The unwearied sun from day to day,
Doth his Creator's power display.

And the servants in a well regulated household do the same, where a good example has been set them.

(Harry and his mamma take tea.)

H Now, mamma, the table is cleared, and the lamp, like a fixed star, stands in the centre.

M (Smiles). I see you have caught the language of the astronomers, though you have not yet mastered their ideas. Are you persuaded, Harry, the sun does not move, or have you any doubts on the subject?

H I am persuaded, mamma, because you say so; but ——

M But against the evidence of your own senses. You were about to say ——

K Well, it does seem strange, don't you think so?

M It is an optical illusion.

K What is that?

M Optical has reference to the eyes; illusions are the deceptions which our faculties practise on us; but to make it clear to your understanding, what you see is unreal!

K How then am I to know when what I see is real, or unreal?

M By bringing your own judgment to bear on the experience of others. Do you remember our last journey from London, when we travelled by the express train?

K Oh yes, mamma, at what a rate we came! the last half-hour especially, when the train was behind time.

M Do you remember observing how every object seemed to fly past us?—trees, houses, people—it was only the moon that succeeded in keeping up with us, and she seemed to be travelling at a great pace.

L Oh yes, I remember, the man with the flag, the station, and the lamppost—whiz for a moment, and then they were gone.

M But you are convinced, are you not, that it was a mere optical illusion, that the station is precisely where it was, that we shall see the same trees on our return to London, standing where we left them?

L Well, I suppose so.

M Their movement was only apparent, and caused by the swiftness with which we were moving at the time, in an opposite direction.

L Just so, mamma; of course I do not suppose the trees and houses were running away from us.

M Then carry out the idea, and you will perceive how it is that the sun *seems* to move, while in fact, it is the earth that moves, and we move with her.

In Oh, now I understand; it is the earth that moves, whilst the sun stands still.

M The sun is one of the many fixed stars in our firmament, shining by his own light, and the centre of our system, whilst the earth is a planet or wandering star, moving round the sun, from which it derives its light and heat.

In But how does this cause day and night?

M Thus; the earth is a ball or sphere, which means that it is round, or very nearly so, shaped like this orange, which I will put my pencil through; the pencil will serve as an artificial pole, and help to illustrate the problem; the lamp will represent the sun, and you can place the orange in any position you will, with reference to the lamp, and you will see that only one-half can be illuminated at a time, owing to its being round or spherical.

In (Tries the orange on all sides). I see that it is so.

M That portion over which the sun shines, is day; while the remainder over which the sun has no influence, is night.

L The dark side is night?

M Yes: and if the earth did not move it would remain night; but the earth turns on her axis, or imaginary pole, which this pencil represents, once in every twenty-four hours, and this is why day and night succeed each other.

L But all cannot have day at the same time?

M Certainly not; people living exactly opposite to us, or at our antipodes, have their day, whilst we have our night; we speak of the sun as rising and setting, as being nearer to us in summer than in winter; but in truth all the phenomena we experience are caused, first by the earth turning on her axis once in twenty-four hours, which gives successively to all her inhabitants day and night, turning round herself remember fromwest to east, thus: (revolves the orange round the pencil), at the same time that she moves round the sun, once in every three hundred and sixty-five days, which forms the year. By the same rule, that portion of the earth which is opposite to the sun during her progress, and receives his rays direct, has summer, whilst the less favored portion, has winter.

K. Then it is the earth that is always moving, that causes day and night, and summer and winter; that's what puzzled me. Why do people and books speak of the sun doing this, and doing that, when in truth he stands still and does nothing?

M. Did I not tell you there would be much to unlearn? The ancient astronomers were not acquainted with the facts I have related to you; they believed as you did half an hour ago, that the sun moved; their fables represent Isis, the moon, as weeping for the absence of Osiris, the sun, uncertain when he disappeared, whether he would return to bless them with his light.

H Oh, how much happier we are than the ancients.

M Yes, and the longer you live the more you will perceive how much we have to be thankful for; but bear in mind that we are working on the knowledge of the ancients; that we owe them the earliest discoveries, which we have since worked out and improved upon.

H What did they discover?

M They discovered the Zodiac, calculated eclipses, laid down rules for determining latitudes, and longitudes, the greater, and lesser circles, some of which divide the globe into equal, and some into unequal parts, and we show our gratitude and respect for their learning by retaining their phraseology, or mode of expressing themselves, when speaking of their benefactor, the sun, whom they worshipped.

H Did they pray to the sun?

M They knew no better; they had their temples dedicated to the sun in days of comparative ignorance. I am speaking now of the Egyptians, who were the great astronomers of the olden times; it was they who made the Zodiac, and divided the stars into constellations. To this day we retain their forms of speech, even though grotesque, and say, "Aries the Ram, Taurus the Bull, &c." Can you repeat the twelve signs of the Zodiac?

H Not perfectly, mamma.

M Well! it is hard work this learning by heart what one does not understand, or quite see the use of.

H Tell me the use, and I will learn them all to-morrow.

M I am afraid, Harry, there will hardly be time to tell you about the Zodiac this evening; I would prefer your thinking over what I have said, for knowledge is like food, it is not the quantity you swallow, but the quantity you digest, that will benefit you. In speaking of the Zodiac I have digressed a little, but as yet you do not comprehend the cause of the seasons; how summer succeeds to spring, and winter to autumn.

H I think I understand the cause of day and night though.

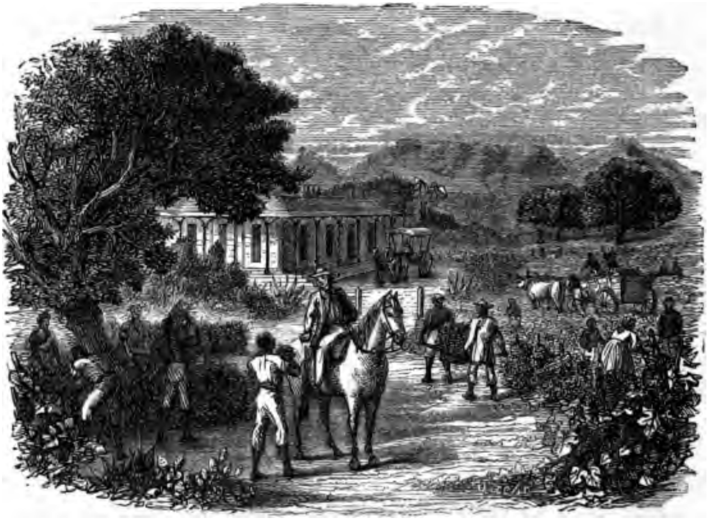
M I am rejoiced to hear you say so; now you must prepare for a good night's rest, and when you wake in the morning you will remember——

H That the earth has been on the move all the time, taking me with her——

M That you have both been turning your backs on your bright friend, but are very glad to greet him once more, when Aurora, with her rosy fingers, shall undraw the curtains of the east.

H Thank you, dear mamma; please to write it all down, and don't forget about the rosy east.

Harry embraces his mamma, and departs.



CHRISTMAS ON THE SOUTHERN SIDE OF THE EQUATOR.

CHAPTER III.

Truths preserved in Memory always ready for use—The Seasons—Imaginary lines, and real results—Harry finds Astronomy not so dry and disagreeable as he was led to suppose—The Earth flat at the Poles only—The rolling Sailor becomes a representative man by exhibiting the Earth's progress round the Sun—A difference in latitude resulting in Grapes at Christmas—Interruptions to Study—Harry's annoyance—His Mamma consoles him.

H Now, mamma, we are once more quiet and alone, and I have thought over all you said yesterday evening, and learned the signs of the Zodiac besides.

M You were right to commit them to memory; they will be ready for use when wanted.

L What is a zone?

M A belt; the leathern girdle you have round your waist represents a zone, or belt. Now let us converse about the seasons. First I will draw a line round the orange which shall represent the equator, because it will divide the orange into two equal parts—hemispheres as these halves are called.

L Then the ends of the pencil passing through the two halves will serve for poles?

M Just so; but all these lines, remember, are imaginary; I cannot persuade this orange to move round the lamp, revolve on its axis, and present first one hemisphere, then the other to the light, unless I use some physical power; God does all this without the aid of any visible power, so that the ball on which we are placed, rolls on without ceasing through space, because He has commanded it should do so, supported only by His almighty will.

H. Oh, mamma, how wonderful all this is! how glad I am I have made a beginning! I think I shall like astronomy more and more every day.

M. The more you study the works of the Great Creator, the happier you will be; God has given us intelligence that we may seek Him in His wonderful works; had he condescended to instruct us Himself, and teach us the scientific principles on which the Universe was constructed, there would have been no exercise for our faculties; knowledge is the reward of patient study.

H. And not so dry and disagreeable after all as I thought it.

M. The day will come, Harry, when you will be ashamed of having thought it so.

H. Ah! but then I might have gone on

thinking it so, had you not taken such pains to make it pleasant to me.

M Well, Harry, let us be grateful for our opportunities, and make the most of them. You perceive now the meaning of the words used by Job, who has written one of the oldest books extant, when he speaks of the world as being hung upon nothing.

H Yes, mamma, I see it was the work of God; whilst we are obliged to put the globe on a stand, draw lines in all directions, and then turn it with the hand.

M You have got the right idea, and I dwell on the subject to prevent confusion. I use the orange because it is easy to move, and it well represents the earth, which is somewhat flattened at the poles.

H Why is that?

M It is caused by the swiftness of the earth's motion from west to east, as she turns on her axis. The poles represent north and south.

H Why is it always cold at the north pole?

M Because the pole is so far from the sun.

H Is the south pole equally cold?

M Just the same; the centre of the earth which the equator represents, being always opposite to the sun, receives his rays direct; but the further we remove from the equator, the cooler the climate becomes, because his rays then come to us obliquely.

H What is that?

M Oblique means slanting or sideways, thus: the fire gives a fierce heat to those who are opposite, but a moderated heat to persons placed at the side, though not really further off.

H That I know to be true, and I wonder it never occurred to me before to ask why it is so.

M Because, as in a thousand other instances, the wonders passing daily before our eyes, do not excite any deep reflection; whilst the merest trifle that is new to us, makes an impression on the senses. Superior minds are not content with trifles however, but are always in search of great truths, and busy investigating causes.

H Mamma, do you think my mind will ever become superior?

M I hope so, otherwise I should not waste my time in trying to lay a foundation for your acquiring branches of knowledge, which many contrive to dispense with, but which I hope my boy will be the better, and the happier for.

H You may depend on my getting all the knowledge that comes in my way; I am not quite so stupid as to turn my back on knowledge when I get a chance.

M Then let us proceed. To explain more fully the cause of the seasons, you must understand that did the earth, whilst revolving round the sun, go at a steady pace, walk even and upright as it were, preserving her perpendicular carriage, one pole over her head, and the other under her feet, whilst the more prominent portion, by which I mean the equator, was presented to the sun; then the inhabitants of those equitorial regions would get all the heat, whilst those who were further removed from the sun, would get very little, or none at all; with some it would be perpetual summer, with others perpetual spring, autumn, or winter, according to their locality.

H Then how does the earth manage to give us all the seasons by turns?

M Do you remember a sailor we observed a few days since walking in the middle of the road?

H Oh yes; he rolled from side to side; I wonder whether he ever got straight home?

M Home, I trust, but certainly not straight; he had contracted a habit of swaying his body to and fro, by adapting himself to the rolling ocean; my language is not scientific, Harry.

H Oh, never mind that, mamma, so you make me understand you.

M Now, imagine the earth if you can, reeling to and fro during her progress round the sun; at one time the north pole is presented to the sun, at another the south. The poles are never near enough to the sun to get any heat, and snow and ice are the characteristics of those inhospitable regions; whilst the equator or torrid zone being always opposite the sun, has continual heat.

L But we have all the four seasons in the course of the year?

M That is owing to our living in a temperate latitude.

L What do you mean by latitude?

M Distance from the equator, north and south. We in London or Greenwich live in a latitude of fifty-one and a half degrees north of the equator; I will show you our position first on the globe, then on the map. (Points out the position of London).

L Does the earth approach the sun in summer?

M It is not so much that the earth approaches the sun in summer, as that by rolling on her course she brings our northern hemisphere opposite to him, and thus we get his beams direct. (Turns the orange, so that first one end of the pencil approaches the lamp, then the other.)

L Oh, thank you, mamma; now I understand how it is we have summer and winter by turns, that the wintry sun does not warm us with his rays even when he shines ever so bright.

M You perceive why it is the earth cannot furnish the inhabitants of her temperate zones with a perpetual summer—how it is that we have our summer, whilst people living in a latitude 51½ degrees south of the equator have their winter.

L (Thinks.) Can it be possible that they have hot weather at Christmas?

M Quite possible. It seems strange to English people after crossing the line, as we speak of the equator, to be gathering the ripe grapes from the vines at Christmas, and to be thinking of their friends at home, eating their dried raisins over a blazing fire.

L And many of them thinking it strange without exactly knowing the cause.

M I am afraid that is the case with a great many travellers. Do you clearly see the cause of the seasons?

L Yes, mamma; I am not such a baby as I was. I think I can manage now without the pencil and the orange.

M You are wishing to get on, and learn something more of latitudes and longitudes, which determine distances north and south of the equator, and east and west of Greenwich.

L Mamma, I think I can understand the globes and maps now with a little assistance, but I have not yet made out clearly what longitude is, and why it is not marked on the globe like the equator.

M You have had enough for one evening, I think.

L Oh, mamma, there will be more interruptions, company coming, and then we cannot go on with our pleasant conversations.

M We shall have other duties, and other pleasures to occupy us, and distract our attention, but you may still find time to think, and thinking will help you to arrange it all in your mind, so that you will have your lesson perfect. Who knows but you may discover the longitude before our next quiet evening!

L You are laughing at my impatience.

M I rejoice in your increased anxiety for knowledge. And now my darling good night.

THE GREATER AND LESSER BEAR.

CHAPTER IV.

The Cousin's visit—What is an Orrery?—The Planets and their Satellites—Harry extends his knowledge of the World in which he lives by learning something of the Worlds around him—Jumping to conclusions—Has to restrain his impatience—Our Antipodes—Everywhere an equal portion of Light—The Esquimaux—The Arab and the Desert—Episodes, and of what use—Noon announced by the firing of a Cannon.

Well, Harry, are you sorry for the interruption?

H Oh, no, mamma, I enjoyed my cousin's visit very much.

M And I showed your aunt our conversations on astronomy as far as they go, and she was very much pleased with the idea of my having them printed, and says she should like to have a copy when complete.

H And I know somebody else who would like to have a copy I think.

M Who is that ?

H My cousin George; he is several years older than I am, and knows something of geography, but nothing of astronomy ; he says he never had any taste for it.

M How should he ? Do you like venison, Harry ?

H I don't know, mamma, I never tasted any ; why is that ?

M Because venison as every day food is a luxury beyond our station in life ; our neighbour, Lord L——, has plenty of deer in his park, and when, occasionally, a haunch has been sent us as a present, you have not been of the party invited to partake of it; but your father and I enjoy venison very much.

L I see, mamma, what you mean; I have no taste for venison, because I never tasted any.

M Exactly so; but the next time we have a haunch sent us, I will ask your papa to let you judge for yourself.

L Thank you, dear mamma.

M And your aunt was suggesting that with a little ingenuity we might construct an orrery.

L What is an orrery?

M A piece of mechanism representing the sun in the centre, and the planets each in its relative position as they revolve round the sun, with their moons or satellites revolving round them, finished up by a broad wooden outer rim or horizon, on which the twelve signs of the zodiac are painted.

L Is there more than one moon?

M Yes; the planet Jupiter has four moons, and Saturn has seven.

K But are those planets like the earth? And are they inhabited by human beings?

M In many respects they resemble the earth, only some of them are much larger; Jupiter, for instance, is fourteen hundred times larger than the earth, but being further removed from the sun, his four moons serve as lamps to light him on his way.

K Do you mean by his way, that he is always journeying like ourselves?

M He is a much greater traveller than we are, that is, than the earth; for owing to his great distance from the sun, he takes twelve years to perform his annual circuit; whilst he turns on his axis once in ten hours.

K Then he has days, and nights, and seasons, just as we have.

M He has days, and nights, and seasons, certainly. So far he follows the general laws which God has laid down for the government of all the planets; but his days are shorter than ours, in winter not more than four hours of light, and in summer about six. At the period of the equinoxes, that is in spring and autumn, the days and nights, as with us, would be of equal length all over his immense surface except at the poles, namely, five hours long.

L Can Jupiter be inhabited? and if so, how can his inhabitants find time for study, and for all they have to do?

M We are now getting into a very abstruse inquiry, though an interesting one. No telescopes have yet been made sufficiently powerful to inform us whether the planets are, or are not, inhabited; but as every portion of our own planet, including air and water, teems with life, we may reasonably conclude that the "thousand worlds around" us were not made in vain. Some astronomer has objected to the idea of Jupiter being inhabited on account of the shortness of his days; but as we have people on earth who find the days too long for them, such persons would be better satisfied with the Jupiter arrangements than with those of earth.

H I think I know who those people are; they are the idle people who grow tired of having nothing to do; but almost everybody on earth is so busy. Surely God would not have made so large a world as Jupiter full of idle people.

M You are jumping to conclusions, Harry; first let us accept the possibility, or probability, of the planet Jupiter being inhabited. We can form no idea of what their occupations would consist, neither can I see any objection to their taking a nap of four or five hours oftener than we do, that is than some of us indulge in, provided they make the most of their time when awake; if their days are short, their years are long. It might be convenient to persons having long journeys to take, wishing to visit countries at their antipodes for instance, to have a long summer before them for such expeditions, whilst to persons wishing to study, a long winter might be convenient; but whatever the nature of their occupations, you may be certain that God has placed them on a planet adapted to their tastes and habits, even as the Esquimaux, who reside within the arctic circle of our own globe, think themselves a happy and a favoured people, though deprived of the light of the sun for three months of the year.

L For three months at a time! Is it possible that any people can live for three months without light?

M There are Englishmen who have thus lived; you must have heard of Sir John Franklin.

L Yes, mamma, I heard papa speak of him, how he had been frozen, or starved to death. Why did he take such a dreadful voyage when he might have staid at home and been comfortable; was he a poor man?

M No, my dear, it was not poverty that led him so far from home, to encounter so many hardships; knowledge was required, and he felt it his duty to go himself, and ascertain whether a north-west passage could be found through the ice. When we consider what he and his brave companions suffered, during a journey that came to so tragical an end, we may well be proud of our countrymen, whilst we deplore their fate: but for that spirit of enterprise, it would only be a geographical conjecture instead of a fact, that there is a north-west passage—that there are countries inhabited by human beings, who lose sight of the sun for three months in the year, whilst their opposite neighbours, who are living within the antarctic circle, (should the region of the south pole be inhabited), never lose sight of him at all during that period. The sun is always above the horizon at one pole, whilst always beneath at the other—they take it by turns to have light and darkness; for every country on the face of the globe enjoys an equal portion of light, an equal amount of justice, if I may permit myself such an explanation of the phenomena—the inhabitants of the equator have twelve hours day all the year round. In proportion as we recede from the equator, so the lengths of the days and nights become unequal; if our longest day, which occurs at Midsummer on the 21st June, has sixteen hours of light, so our shortest day, which takes place on the 21st December, has but eight. I have already told you that persons in opposite hemispheres have opposite seasons.

L And opposite day and night, I suppose?

M For once you suppose wrong, and this brings us back to our longitude, where we left off before your aunt and cousins visited us.

L There, mamma! I said the interruption would put us out.

M It has, my dear; but it is not to be deplored; every now and then we shall have to put back a little, and as I trust we have plenty of time before us, without being reduced, like the poor Esquimaux, to feed chiefly on train-oil the while, besides being obliged to trim our lamps with the same, for three consecutive months.

K Oh, mamma, what a fate! how can they be happy or even contented?

M Habit reconciles them, and it is well known that the Finlanders, who occupy the northern portion of Europe, seldom survive any attempt for making them more comfortable, according to our notions of comfort, by transplanting them further south. They miss their old associations, and, like the Swiss when removed from their mountain homes, they pine and die.

K One moment, mamma; I am looking for Finland.

M And Lapland?

K Yes; I have them both.

M That is the true way of learning geography.

L But what were you going to say about Lapland?

M The Laplander loves his reindeer as the Arab does his horse; both are regarded as members of the family, and a brisk journey across the snows in a sledge drawn by deer, is probably as exhilirating to the arctic gentleman dressed in furs, as a race would be to the Englishman, or a scamper across the desert to the Arab; all these are earthly considerations however, and leading us away from the subject of the longitude.

L Oh, mamma, I like these little ——

M Episodes or digressions.

L Yes; these little histories; they help to fix the hard words in my mind.

M That is why I digress, fearing lest you should get tired of dry facts, or forget the scientific terms. Now let us consider the question of longitude; I remember your asking why it was not as well defined on the globe as latitude.

L That is what I have not yet made out.

M The latitude is well defined, because we have two points which determine its locality: there can be no doubt but that the equator is situated exactly between these two points; but as the globe revolves from west to east, and there are no points to distinguish the one from the other, so east and west are mere relative terms as far as countries are concerned. If we face the north, the south will be opposite; those countries which are on the right hand will be to the east of us, whilst those which are to the left, will be to the west; but as east and west have no material boundaries, so our dignity induces us to fix the first line of longitude at London, or rather Greenwich, where our observatory is situated. We speak of those countries which are on the right hand of London, as east, and those that are to the left, as west; by the same rule the French geographers have made their first line of longitude to pass through Paris, whilst the Danes and others are content to place their starting point at the Faroe Isles.

K Pity they were not all agreed about it, mamma.

M I think so, too; for in speaking of latitudes and longitudes allowance has to be made, and calculations entered upon, before each can accept what the other considers to be the right longitude of any given place. Now I wish you to consider it as a fact, that the true idea of a place is only to be obtained by ascertaining its exact latitude and longitude; and I should advise your learning a certain number of the chief cities, and their latitudes and longitudes, every day,—say six; you will thus acquire a good knowledge of geography, and find it easy to fill in the lesser places afterwards. I will write down those I wish you to learn to-morrow. If once learned by heart, you will never afterwards forget them; the chief cities will serve as landmarks for small towns; you will easily ascertain whether the latter are east, west, north, or south of the former. This will enable you to determine something of the climate, to say, if to the east, they have the sun earlier in the day than we have him, for longitude determines the hour of the day; if the place is in the west, you will then remember that the sun visits them after us.

L Mamma, that is just what I am wishing to know. Do not the people in Paris have day at the same time that we have? Was not yesterday the same day of the month with them as with us?

M The same day of the month, but not the same hour of the day; let me show you how that is. In default of longitude, the brass meridian serves to determine the midday to those above the horizon—midnight to those below. All persons living in the same longitude with ourselves have day at the same time, on both sides the equator; when it is twelve o'clock with us, it is twelve o'clock with them. The arctic regions are an exception however, owing to the great obliquity of the earth. In those high latitudes the sun is unable to reach them, except during the summer months.

K And yet it is not summer on both sides the equator to people living in the same longitude with ourselves.

M Their day is the same, but their seasons are the reverse of each other.

K I shall have to think over that.

M Do so, my dear; and let us finish up with Paris. I must tell you that one of my favorite walks when there, was to see a small cannon so planted in an enclosure in the Luxembourg Gardens, that precisely at twelve o'clock at noon, it announced the hour without any assistance being given, beyond that of the sun.

K How was that managed?

M The cannon was so placed that, at twelve o'clock, the sun's rays became vertical, and an explosion took place in consequence. Instruments for measuring time are by no means limited as modern inventions. The dial is mentioned in Scripture; but gunpowder and clocks are comparatively of a much later date.

L Who invented gunpowder?

M The Arabs are supposed to have been the first inventors, and clocks were first made at Geneva in Switzerland. For what are you searching?

L For Geneva. I have it; 46° 25″ north, 6° 30″ east longitude.

M To-morrow you shall calculate the difference of time between them, and us. I was going to observe, our forefathers in the time of the Saxon King Alfred, burnt candles which lasted six hours; but our people in a general way judged of time by the height the sun had obtained in the heavens, by the increasing and decreasing of the shadows of the trees and other objects. The shepherds who watched their flocks were seldom at a loss for a sign, observation being a surer guide to them than an almanack. The places I have now marked for you to learn, are St. Petersburg, Calcutta, Madrid, Cape of Good Hope in Africa, and Philadelphia in America, and Jerusalem; several problems will be thus included.

H I am afraid my lessons will puzzle me, and that you will think me stupid.

M If you find you do not get on comfortably without me, do not worry your brains, but wait till I can further assist you; if, on the contrary, you can manage without me, so much the better; also I wish you to repeat how many degrees all great circles consist of, and how many miles go to a degree: also, to divide the great circles into halves and quarters, thus: Calcutta, which is in a latitude of 22° north, is nearly on the tropic of Cancer, one of the lesser circles; whilst the longitude being 90° east, is nearly a quarter of the globe removed from us. Now, Harry, can you tell me whether they have the sun before or after us in the day?

H (After a few moments' reflection). Before us.

M How much before us?

H If Calcutta is a quarter of the globe away from us, then there must be a quarter of a day difference in the time.

M That's a good boy; I see you understand the problem; the day is how many hours in length?

H Do you mean day and night?

M Yes; a sidereal day includes both.

H Then it will be twenty-four hours in length.

M And a quarter of twenty-four is——

H Six hours.

M Right. Thus you see the inhabitants of Calcutta have the sun six hours earlier than we have him. Now supposing it is nine o'clock in the evening with us what o'clock will it be with them?

H Three o'clock in the morning.

M And what of their seasons?

L They are north of the equator, I think.

M Yes; 22° north.

L Then they have their summer and winter at the same time that we have ours.

M Right again, only that their summer, owing to their proximity to the sun, is much hotter than ours, and their winter is not so cold.

L How cold it must be at St. Petersburg!

M Yes; St. Petersburg is 60° away from the equator, and 30° to the east of us.

L None the colder for their distance from us, I suppose?

M None whatever.

L I will learn the latitudes and longitudes to-morrow, mamma, as you wish; the difficulty is not so great as I had at first imagined.

M There is nothing like looking a difficulty in the face; if you shrink like a coward the difficulty gets the better of you, but if you are brave, and determined to conquer, you get *the better* of the difficulty.

H Well, mamma, I hope nobody will ever say that I am a coward.

M I hope not; you are the son of a brave Englishman, and when your papa returns to this country I think your success will be a source of pride and pleasure to him.

H That is one reason why I wish to work hard that I may give him an agreeable surprise on his return.

M Before we dismiss the subject of longitudes let me ascertain whether you understand them. There are twenty-four parallels of longitudes passing from the north to the south pole, and cutting through the equator, and lesser circles, at a distance of 15° from each other, which correspond to——

H The twenty-four hours of the day.

M What will you do for half hours, quarters, and minutes?

H Well, I suppose, I must go to my Tutor's Assistant and divide according to the rule in arithmetic.

M You cannot go wrong if you do that.

There is no line of longitude passing through Paris for instance; but the brass meridian will assist your calculations. If places are in opposite latitudes or longitudes, then add them together to ascertain the number of degrees they are distant from each other; but where two places are on the same side of the equator or of London, then subtract the lesser from the greater number of the degrees they are apart, and this will give you the difference of latitude or longitude between them.

H Thank you, dear mamma, I will sleep upon it, perhaps dream about it; at any rate it will be all right by to-morrow.

M Good night, my brave boy, may God bless your endeavours!

H Good night, dear mamma; I shall not forget the Englishman's motto.

M What is that?

H To conquer or die. I think I shall be a soldier.

THE DECOMPOSITION OF WATER.

CHAPTER V.

Climate determined by Latitude, and time by Longitude—What Worlds are made of—Harry takes a dip into Geology and Chemistry—One Truth never contradicts another Truth—How an excellent Memory may be obtained—Air—what it is composed of—How a drop of Water may be turned into thin Air and back again—Harry boasts of his Courage—Every substance in Nature capable of being analysed—Evaporation—Decay—The law that leads to renewed beauty and Life Eternal—Good Night.

M Well, Harry, did you find the latitudes and longitudes come to you in your dreams?

K No, mamma, I had to search for them, but I think I have them all correct. St. Petersburg is in 59° 56″ north latitude, and 30° 19″ east longitude; Calcutta is 22° 35″ north, and 88° 25″ east.

M That's all right; now what is the difference between them? Take round numbers.

K I do not quite understand you.

M I mean to say that as you have a great many of these places to recollect, it will be easier done, and answer our purpose as well, that you take the nearest number, for instance, if I enquire the age of one of your friends of his mamma, much as I value truth, I am satisfied to learn that he is ten or eleven years old, without requiring to know how many months and days have elapsed since he completed his tenth or eleventh year; at the same time, it is of importance for special purposes, that his birthday should be registered. Truth requires us to be exact in conveying right *impressions,* and none else; but as time is of *value, we should* avoid being tedious.

L Now I understand.

M Then you will consider St. Petersburg as 60° north, and 30° east, as having the sun——

L Two hours earlier than we have him, and four hours later than he appears to the inhabitants of Calcutta.

M That's right. What is the difference in the latitudes of those places?

L There will be a difference of about 37°.

M Now that will suffice to give you an idea of the difference of climate between the two places. Did you look for Jerusalem?

L Yes, mamma, 31° 47″ north, 35° 13″ east.

M And Cape Town in Africa?

L 33° 56″ south, and 18° 28″ east.

M What is the difference of latitude between those two places?

L Nearly 66°.

M And longitude?

L Nearly 17°; that is, 16° 45″.

M *And Madrid?*

L Is 40° 24″ north, 3° 43″ west.

M And Philadelphia?

L Is 39° 57″ north, and 75° 9″ west.

M Now what is the difference between them?

L Not much difference in the latitude, although they are so far from each other.

M In what does the difference consist?

L In the longitude.

M Both to the west, you said?

L Yes, mamma; had Madrid been nearly 4° to the east, it would have been still further from America than it is.

M Can you tell me the exact difference?

L 78° 52″.

M What difference would that make to them?

L I must think a little.

M Divide by 15 for the hours.

L Somewhere about five hours then; I will work the problem with exactness, if you wish it.

M I do wish it, but not now, because our moments are precious; I only wish to ascertain further about the light.

K They have the sun long after the inhabitants of Madrid.

M When it is ten o'clock in the morning at Madrid, it is——

K About three in the afternoon in Philadelphia; what I want to know mamma is, more about light, what the sun was made of, and what the earth was made of?

M You have asked me a question difficult to answer with exactness; it is supposed the earth was originally made of gases.

K And what are they?

M Gases are elastic fluids; I am afraid you are not much the wiser for hearing what worlds are made of.

K Oh, but I shall be; I know water is a fluid for instance.

M And you know your Indian rubber is elastic, so you must put the two ideas together.

L I should have but a muddy world out of the two.

M And that's just what it was, till out of the mud or earth, came beauty. The sun shines; the flowers rise from out the dirty ground that spoils my carpets, and with the light the blossoms expand. I am now uniting the poetry of creation with the matter of fact.

L Yes, mamma; but I am wanting the exact truth if you can tell it me.

M You want the knowledge that thousands have been searching for, and accumulating by slow degrees.

L Oh, mamma, I know I must work hard to get as much knowledge as I want.

M Your time cannot be better employed; but the questions you ask me involve various branches of science. To explain properly about gases, I must go into chemistry, which treats of the component parts of every substance in nature; it is highly necessary, however, for the student in astronomy, to have some knowledge of geology and chemistry, and as you grow older, I wish you to study these sciences systematically; each new science throws a light on the other, and one truth never contradicts another truth.

K Then let us stick to truth, mamma, and just tell me what you know.

M It will suffice for the present that what I have to tell you must be very elementary.

K I do not quite know the meaning of the word elementary. I suppose it means that you will adapt yourself to my ignorance—but what are you doing?

M I am writing down the word elementary, and my next gift to you will be some tablets with a pencil, so that you may make a memorandum of any words of which you do not quite understand the meaning, and afterwards search for them in a dictionary; here's a small pocket-book in the meantime.

K Thank you, mamma, that's very nice; I so often want to know a word, or ask a question, and then I forget all about it before I see you.

M One word on the subject of memory, Harry, lest I should be doing mischief; I think you have already an excellent memory.

H Oh, mamma! how can you say so!

M I do indeed, my dear.

H Why, mamma, I am always forgetting things!

M Not when you wish to remember them. You challenged the truth just now, so you shall have it in confirmation of what I say,—it is now three months since I made a promise that had quite escaped my recollection, whilst you, on the contrary, have retained every particular—names, dates, places.

H (Laughs). Oh, I know now what you mean, our game of cricket, and the boys who are to be invited.

M Yes, Harry, I am convinced your memory is excellent, when you determine to exercise it.

L All depends on that, mamma.

M Then exercise your memory as much as possible; in doing so you will strengthen the faculty which God has given you. The greater number of people who complain of want of memory, never even give themselves the trouble to think; they adopt the tone of injured persons, and speak of their deficiencies as though God had very unequally distributed his gifts, or they had been shared out; avoid getting into this habit.

L All very good, mamma, but I daresay they were not well trained when young.

M This brings me to the philosophic portion of your education; and gases, which are supposed to be the basis of all things—the air we breathe, the water we drink, the earth we inhabit, and even the fire we burn, are all composed of gases.

L I had no idea of that; please begin with air and tell me of what it is composed.

M Air is composed of oxygen and nitrogen. The oxygen is the healthful portion: it is the oxygen which gives colour to the cheeks; without it we should die—become black like the coals we burn. Plants inhale the oxygen, and exhale the nitrogen; and this is why they are so unwholesome in a room at night, as night is the time during which they exhale the bad air, after being all day nourished with the good. Hydrogen, which is also the chief component part of water, enters largely into the atmosphere, water being composed of hydrogen and nitrogen—an interesting experiment shows this; what I am telling you, however, is a digression, for we are now taking a dip into chemistry.

L Oh, I like it very much; please continue.

M The experiment I refer to is this: a professor of chemistry shows his students a drop of water; it is composed of two or more gases—it is visible, tangible, something they can both see and feel.

L Yes, I should say so.

M Well, he separates the hydrogen from the nitrogen, and the two gases are instantly dispersed.

K What becomes of them?

M They resolve themseves into thin air, and become invisible.

K You surprise me.

M The chemist's art has been compared to magic; but I think the most interesting part of the experiment remains to be told. The professor wishes to convince his audience of his power over these elastic fluids, and he does so by re-uniting the two gases, when instantly they resume their original form, and become once more a drop of water.

K Did you see him perform this experiment?

M No; I was not present on the occasion, but the circumstance was related to me by one who was, and whose word is not to be doubted.

K Mamma, I hope you will forgive me, but I cannot help doubting.

M (Laughs.) You little sceptic! There, write the word down, and you may write what I am going to add, "Blind unbelief is sure to err." Mr. F., who has a laboratory of his own, will soon convince a little shallow-pated philosopher like you. I daresay some of his experiments will make us both look rather blue; I only hope you may not be frightened.

L No danger of that. I do not think anybody could frighten me; but I should be so delighted to see his experiments. Was that where you and papa went last winter?

M Yes, my dear; and I am sorry you were not with us, but your papa thought you would be too young to understand what was going on. Our kind neighbour is never so happy as when giving instruction and amusement to others, so there will be no difficulty in securing his assistance in the way of convincing you. For the present you must take my word that every substance in the creation is capable of being analysed, and its component parts ascertained, by a skilful chemist: this is a portion of his daily business. We live in a world of perpetual change, where nothing is lost: the shingles on the sea shore have had their sharp edges taken off by contact with each other; those sharp edges are gradually reduced into the fine sands that form the boundary of the ocean. In the same way the hard rocks, of which some of our mountains are formed, are daily crumbling into dust, detritus as we call it, and this again mingles with the earth around, and alters the character of the land. The science which treats of these mighty changes is called geology, and many a pleasant evening I promise myself in conversing with you about geology.

H. How kind you are to me, mamma!

M. We have not got very far this evening, Harry; but the more we advance, the more I perceive how much there is to be done in laying a good foundation for your clearly understanding the first principles of astronomy, especially as you wish me to begin at the beginning. One word more before you leave me. On a fine starlight night you may have observed those white fleecy appearances in the sky called nebulæ by astronomers?

L I think I have.

M They are supposed to have been the original materials of which worlds are made—gases, substances of no particular shape, without form, and void. Such may have been the appearance that this planet presented ere God called the elements into action, and formed them into a ball. In accordance with the first law of motion, this ball would have gone on for ever in a straight line, but that the Creator had another destiny for our globe: and I have already shown you that the earth does not move in a straight line—that it performs a circle round the sun in company with other planets. To-morrow evening, if we are permitted, I will endeavour to give you some idea of our solar system, and the philosophical laws *by which it is* governed.

L. Thank you, dear mamma; and I will look out the words I want in the dictionary.

M. Let me add one to your list that I think we shall require. (Writes.)

L. Evaporation!

M. Yes; liquids become solid under its influence; my ink dries up; the gum arabic which I diluted with water a few days since takes an inconvenient consistency. Your Indian rubber was once a resin flowing from a tree; it is now become hard, though still elastic. The boiling water disappears in steam, whilst the solid coals are reduced to ashes, or ascend in smoke; mists form into dew, and vapours, unless dispersed by the winds, settle themselves around us in fogs of more or less density. In the country where the hydrogen prevails, the atmosphere becomes filled with minute drops of rain; in London, where smoke, or carbon as it is called, mingles with the other gases, a dense yellow fog is the result of those stagnant vapours which refuse to rise after the sun has called them forth, until dispersed by the winds.

This great lesson you may now acquire, and daily ponder over. We live in a world where all is change, but where not a particle of matter ever is, has been, or will be, lost: it only alters in form: the face of nature is one ever varying scene of decay and reproduction—trees, plants, and flowers bud, bloom, come to perfection, then fade and die, but none are lost: the shrivelled leaves fall to the earth, which they help to fertilize, and germs of life remain, which in due season rise and supply the places of the old forms we have lost. Neither do we escape the general decay that is going on around us: the people who are now old and withered, were once young and blooming—they die, and we restore them to their kindred dust.

H Oh, mamma, I do not like to think of it—to think that you and papa should die and leave me here!

M We cannot alter God's laws, Harry, neither would I wish it were it possible. If your father and I are destined to leave you here, I hope our mission on earth will be fulfilled before we go—that we may be permitted to give you such an education as will fit you for the station in life in which it has pleased God to place you. You are aware that it is only your body that dies—that your soul is immortal, and will live for ever?

H Yes, mamma, I know all that.

M Then you can never be really unhappy whilst you bear in mind your own immortal destiny. A few years and you will meet us again; we shall leave you cheered with this hope.

H I know that all you say is true, but I do not like to think of it.

M Neither do I wish to sadden the bright morning of your young existence by forcing you to dwell on painful subjects; as time advances you will think and feel differently. Now let us wish each other good night.

* * *

FINGAL'S CAVE, AS SEEN DURING AN ECLIPSE OF THE MOON.

CHAPTER VI.

Studies again interrupted—Harry learns his Papa is coming home—In his haste to know more about our Systems, he says he is sorry, but like our Planet he cools down, and acquires consistency as time goes on—Brushes up his Classics for the occasion, and compares his Papa to Ulysses—The Earthquake in Lisbon—Centrifugal Power—The effort the Earth is making to have her own way, and how the Sun exerts himself to counteract her tendency to fly off in a tangent—Phœbus and his fiery Steeds—The rolling Planet and the fixed Stars—The Moon an excellent Servant to the Earth, but not her Slave, as she knows how to maintain her own position—A practical lesson on Eclipses, occasioned by Harry interposing his head in the way of the light—*He traces the* Moon's progress through the Signs of the Zodiac—*Finishes up with the* great Herschel.

M Harry, I have news to tell you.

H Oh, mamma, I guess what it is—you have had a letter from papa, and he is coming home.

M Yes, and sooner than he expected.

H How soon?

M Early next week, so we must bring our conversations to an end.

H I shall be so sorry.

M What, sorry your papa is coming home! Ungracious boy!

H Not sorry papa is coming, but I shall miss these pleasant evenings.

M Your papa has more knowledge than I possess, and if his stay in England be prolonged, perhaps he may assist in your education himself; but if, on the contrary, his leave of absence should be for a short time only, then it will console me for his departure that I have you to talk to; but why do you laugh?

H I was thinking of Ulysses and his wanderings.

M Are you pleased with Fenelon's beautiful work?

H I am delighted with it.

M Then we both have our resources: the winged hours will fly swiftly any way; when your astronomy is interrupted, there will be the classics. Now let us make the most of our opportunity. I am wishing to give you the grand lesson this evening for which I have been preparing you for some time past. We are still at the beginning remember.

H Yes, mamma, the gases which had to be got into shape.

M You must not speak otherwise than with reverence on such serious subjects.

H Forgive me, dear mamma, I am all attention, and curious to know how this wonderful world was formed.

M We can only exercise a reasonable conjecture, Harry, and suppose the earth an assemblage of gases, hot or incandescent, as geologists say, moulded into shape; that it gradually cooled down; that the hot liquid substances in process of time separated from each other, and became the elements as we see them; that the waters, originally dense as quicksilver, became more and more pure and transparent, whilst the harder portions of the earth became more and more solid; that the rocks, caused by internal fire, shot up through the earth and became the tall mountains, whilst the waters naturally flowed into the hollow places, land being that portion of the earth's crust which is above water.

K And the centre of the earth,—is that solid?

M That we have no opportunity of knowing. No shaft has yet been sunk deep enough to admit of our ascertaining, but we know that beneath the earth in many places there is fire, and that this in volcanic districts is the cause of earthquakes. You have read of them?

K Yes, mamma, I have read of the earthquake in Lisbon, which destroyed so many people in 1750.

M There are places like Lisbon, more liable to earthquakes than others, owing to the peculiar strata; geology determines which are these unsafe localities, and explains why they are so.

H Cannot you tell me the cause of earthquakes?

M It would lead me out of my way to tell you why earthquakes are more frequent in one country than another; but their immediate cause is the effort of subterranean or buried fires to make their escape; in doing this they violently upheave the earth, and overthrow whatever opposes them.

H Thank you, mamma, now we can go back to the beginning, if you please.

M The surface of the earth has been cooling down to a suitable temperature during our digression. Let me suppose that the Creator carried out his original intention of making it *revolve round* the sun according to the first law of motion, which is this:—a ball issued from the hand of him who hurled it, would move in a straight line, and if no other power interfered to counteract it, would continue to move in a straight line—this we call the centrifugal, or flying off force; but another force is coming into action, which draws the earth off from her original career—the sun now forms the centre of the solar system, and has power to attract the planets towards him, and counteract the centrifugal force—this power, which the sun possesses, is called the centripetal force, which draws the planets to a centre, that is, towards himself.

L How do they get on then when drawn different ways?

M Not at all. What would be the result do you think if a body, any body, were equally attracted in two different directions?

L It would not make much progress.

M Just so: a body equally attracted in two places remains at rest; but if the attraction becomes unequal, what then?

K (Thinks). Two powers?

M Yes, two powers, and in two different directions.

K Then it will follow the greatest attraction.

M That is just what takes place. These two powers are constantly acting and counteracting each other; the earth wishes to have her own way, and move in a straight line, whilst the sun, which is ninety-five millions of miles removed from the earth, is constantly endeavouring to draw her off from that straight line. See! I have represented the sun, and the various planets revolving around him, all influenced by the same laws, the centrifugal and centripetal, which act by turns. The self-willed earth endeavours to have her own way, whilst the sun is equally determined to have as much of his own way as is requisite to prevent the earth from making her escape into space. At various periods of the year this tendency of the earth to fly off in a tangent increases; the sun *exerts his potent* sway to overcome this tendency; thus the sun, who in poetry is called Phœbus, is represented as standing in a chariot and reining in his fiery steeds.

H I remember that picture in my pantheon.

M The ancients, with their charming poetic fictions, had only a glimmer of the truth, and the wisest amongst them would have been greatly astonished could he have listened to my prosaic descriptions of the last few evenings.

H All Greek to him, mamma, I daresay.

M I am glad you do not find your lessons dry and abstruse.

H On the contrary, I am very much amused; I fancy I see the bright chariot wheels of the sun.

M Conquering every difficulty?

H Yes, I suppose so. The earth conquered, and made to revolve around the sun, the other planets would do the same; but you have not told me why the earth is called a planet instead of being a star.

M The earth is a star, and would present much the same appearance to the inhabitants of Venus and Jupiter, that those planets do to us.

L The appearance of a bright star? Where does the light come from?

M From the sun; the earth shines with a borrowed light which she gets from the sun.

L I know we get our light from the sun, but I was not aware the earth was anything more than a dark body.

M And neither is she; that mirror is a dark body in itself, but it has the power of reflecting the light on its surface.

L Why do you call the earth a planet as well as a star?

M To distinguish it from the fixed stars, which are all suns shining by the power of their own light, and the centres of other systems, having dark opaque bodies rolling round them, over which they shine most probably, but are too far off for us to distinguish them.

K Then a planet——

M Is a wandering, rolling star, revolving on its own axis, and moving round another body more powerful than itself.

K And the fixed stars?

M Are so called because they do not change their relative positions. In the course of the night, the many thousand stars we see in the firmament roll over our heads, rise in the east, perform an arc of the heavens, and set in the west; but their movements are only apparent, and caused by the earth turning on her axis, so that in the course of the twenty-four hours the entire starry host is encountered in one direction, or another. The stars seem to move, but in fact it is we who move—who turn from them, and meet them again as we turn towards them.

K Then those stars never move?

M Those stars or suns never move; they are great dignities always at home, having their receptions at stated periods, when we, the planets, are permitted to pay our respects.

I Now I understand you better than when you are so learned.

M I am trying to bring the entire system of the universe before the mind's eye, so that you may grasp the idea at once, and work out the details by degrees, as opportunities present themselves, or your inclination may lead you.

I Thank you, mamma; I shall never rest till I puzzle it all out for myself. But the orrery, and the moon, or moons; what are they?

M I can only answer one question at a time; which are you the most anxious about?

I I think I am most curious about the orrery; but I have an idea that the moons will be wanted for the orrery, and that we shall have to stop for information as to what they are: so the moons first, please mamma.

M That's my sensible boy; we have been getting over a great deal of ground this evening, going at a railroad pace, trying to keep up with the planets; but it takes time to build up systems, and it will be as well to collect our materials before we begin.

H Now I am ready to hear about the moon.

M Then I will begin by speaking of her as a satellite; all moons are satellites or attendants on those planets round which they revolve.

H Do the moons go round the planets?

M Yes; the moons go round or accompany the planets whilst revolving round the sun. The same laws come into action with regard to them that I spoke of just now—the centrifugal and centripetal powers are at work. The moon is the servant of the earth, but not her slave: whenever she wishes to have her own way she exercises her centrifugal power, but is called to order by the sovereign lady, the earth, who exercises her centripetal power as often as the moon goes too far, or attempts to fly off in a tangent. But she is an excellent servant for all that—she knows how to maintain her own position, whilst she increases the dignity of her sovereign; the light she receives from the sun she transfers to her ruler in his absence. She is a faithful servant, at all times performing her rounds with punctuality, influencing the seasons, looking after the tides, and it is not her fault if she is occasionally invisible, or eclipses her superiors. The earth returns the compliment, and eclipses her.

K Oh, mamma, I could listen for ever!

M You are wishing to remind me that human life has its limits, and that I am laying the foundation of an education that might last through eternity, for the subject is inexhaustible.

K Yes, dear mamma, you must die and I must die, but I want to know first what causes an eclipse?

M The most natural cause in the world: there! you have caused an eclipse by putting your head in the light, and throwing a shadow over my paper.

K Is that all?

M And quite enough, for unless you remove your head I cannot continue my writing. Thank you for moving. Now my paper has escaped from your penumbra or shadow, and the light of the lamp comes to me once more unimpeded.

K Do you mean that the earth casts a shadow?

M I mean to say that the earth and her attendant frequently get in each other's way, and then they counteract each other; you know what a shadow is?

K Yes, mamma.

M Then explain it.

K Oh, mamma, you will put it into better language than I shall!

M It is one thing to understand, and another to explain I find. Of what use to have ideas unless we can express them? A shadow is *intercepted* light.

L That is just the word I wanted.

M Your vocabulary is limited at present; but you must accustom yourself to think in appropriate language; I have to bring my mind down to meet yours.

L I know you have, and I am very grateful, dear mamma.

M I think before we dismiss the moon from our evening circle, I must tell you how it is she comes to eclipse the sun.

L Then it is the moon that causes an eclipse of the sun.

M Yes; the moon, whilst passing between the earth and the sun, manages so far to intercept his light, that she causes either a total, or, oftener, a partial eclipse. Now the moon moves round the earth in twenty-eight days, and, consequently, we should have an eclipse of the sun with every new moon did she make exactly the same circuit, or orbit, as her path is called; but the moon makes a little diversion in her rounds, either more to the right or the *left, and so avoids* the blunder as it seems to be.

H That is an eclipse of the sun which you have been describing.

M Yes; an eclipse of the moon is caused by the earth casting her shadow on the face of the moon, which can only happen at the time of full moon, when the earth is exactly between the sun and moon. The moon, being opposite the sun, the earth casts her shadow thus (let the lamp serve as the sun):—if our heads were on a level with the lamp, then the one that interposed would throw a shadow on the other. I cannot afford to dwell on this subject, or I would explain to you the moon's phases, or changes, in making her progress round the earth; how, when she is between the earth and the sun, her bright side is turned towards him, and she being a globe, her dark side is next the earth: at this period of her history we call her the new moon. As she escapes from her hiding place we see her first in the form of a crescent, then one-half becomes visible; after a lapse of fourteen days, she is again opposite to the sun, at the full; after seven or eight days, she subsides into the half moon, and finishing up as a crescent, she finally dips into banishment, when we lose sight of her altogether: she is now called the new moon. And thus she passes through the twelve signs of the Zodiac in the space of one lunar month.

L Does she pass through all those signs I learned by heart?

M Yes, thirteen times in every year; and so do all the planets pass through the signs of the Zodiac, but not at the same rate, for the moons pass round the planets whilst they accompany them, and so have as much extra journeying as you would have if instead of walking beside me when on a journey, you amused yourself by running round me: but you understand why the moon does this?

L Yes, mamma; she transfers the light of the sun to us. Have all the other planets moons?

M Not all; Mercury and Venus are nearer to the sun than we are, and have no moons; Mercury, who is thirty-seven millions of miles away from the sun, and is less than half his size, moves round him in eighty-eight days, his year being little more than three months; whilst Venus, our bright evening star, moves round the sun in two hundred and twenty-five days. The earth revolves in three hundred and sixty-five days, and Mars, who is considerably smaller than the earth, being only one-seventh in size, takes about two years for his annual journey.

K How large is the earth?

M The diameter of the earth is about eight thousand miles.

K What is meant by the diameter?

M The direct line from pole to pole through the earth's centre; if you multiply the diameter by three it will give you the circumference. Jupiter, with his four moons, is one hundred and forty-two millions of miles away from the sun. In addition to his moon he has two luminous belts, which help to enlighten him. Next comes Saturn, who is a thousand times larger than the earth, and has seven moons that we know of, and others yet undiscovered; it may be he takes thirty years in revolving about the sun.

L How slow he must be!

M Consider what a circle he has to perform, and how great his distance: but for his rings of light his would be a sad benighted condition. These stars were known to the ancient astronomers, who calculated their distances, and observed their movements. In the reign of George III., another planet was discovered by our great astronomer, Herschel, whose name it bears. Herschel takes eighty years in performing his circuit, and six moons have already been discovered which accompany him. Within the last few years the planet Neptune has been found to make a part of our solar system, but he is so completely on the outer edge of our knowledge, that there is even less to be said of him than of Herschel: thus our system is complete. I daresay your papa will assist me in giving directions for an orrery to be constructed that will show the movements of the planets round the sun, and of their respective satellites round them.

H I see this is only the beginning of my lessons.

M It is the end of this evening's lesson; it is getting late, Harry, and I shall have to crowd much that I meant to say into a small space; but we can pursue the subject at greater length according to our opportunities, and I will give you fuller information when you are better prepared to receive it, by dwelling on what I have said.

H Thank you, dear mamma.

M And now good night.

THE RAINBOW.

CHAPTER VII.

Harry's last evening with his Mamma—They return to their starting point—Refraction—Light—The Prismatic Colours, as displayed in the Rainbow—Harry fancies he can see straight through the water—His Mamma undeceives him by putting her pencil through a portion of that fluid contained in a basin—Natural Magic—The Giant, as seen at sunset—The difference between Refraction and Reflection—Harry's ideas about a ray of light become more definite—The indefinite multitudes who contribute to our daily comforts—Reflections good to dwell on—The use of Science with reference to Arts and Manufactures—Caxton, and our great *obligations to* him—Comets—their mission and final destiny—

Though eccentric in all their ways, they never clash with other heavenly bodies—Harry and his Mamma discuss the Dragon, then proceed to dispose of other Celestial Phenomena of the Ancient Egyptians—The fifteen Stars of the first magnitude, as seen in our Hemisphere—How should a Globe, which is convex, represent the Heavens, which are concave?—Harry's Mamma explains to him how she overcame difficulties, and puzzled out knowledge for herself, by making her own Maps—Why we cannot see every Star in the Heavens whilst living in a latitude of 51½ degrees—The Conversations come to a close, and Harry regrets he cannot be a little boy for the remainder of his life, so great has been his enjoyment whilst listening to his Mamma.

M I fear, Harry, this will be the last evening I shall be able to devote exclusively to you for some time to come; I will endeavour, therefore, to answer your earliest enquiries about light and refraction.

H This is our seventh evening, mamma.

M And with it, rest; but now for light. I cannot tell you what light is, though its effects are so well known to us. We are apt to speak of the sun as the source of light, because we know that when we lose sight of our great luminary, darkness ensues; but light is older than the sun, for the sun may be after all merely a receptacle for light, and adapted to our system, as the lamp is adapted to our room. The heavens are hung with lamps which no more produce light to us than the lamps we see glimmering through the trees miles off give us light. Many of those stars or suns are so far distant, that their light would take years to reach us.

K Is that possible? What then can light be?

M A substance that comes to us in rays, and those rays come to us in straight lines; but you can see a ray of light.

K Yes, mamma. I watched the rays of the setting sun yesterday evening as they shone through the trees; they were all colours, and so bright—it quite dazzled my eyes to look at them.

M Light is composed of seven colours,—red, orange, yellow, blue, green, violet, and indigo; these colours, and all their intermediate shades, blending and harmonising with each other, are happily displayed in the rainbow.

L I enjoy looking at a rainbow. How is it that we see coloured light in the rainbow, and what causes the colour ?

M Refraction. Light is collected in the drops of rain, which gives us the opportunity of observing the prismatic colours ; when diffused, they fade and grow pale. Light comes to us in straight lines, direct from the sun in seven minutes, until it comes in contact with a denser medium, and then it is diverted from its course ; but I am going to give you a practical illustration of this.

L Oh ! now I see why you ordered a basin of water.

M I did so that we might not be interrupted by the entrance of a servant in the midst of an interesting lecture.

L But what can water have to do with light ?

M Much : water is a denser medium than air, not so dense but that the light can pass through it, though sufficient of an impediment to prevent its going straight through. Observe my pencil, it is perfectly straight, is it not?

H Certainly. What a question to ask me!

M (Smiles). Now look again: see! I have put it into the basin which is half full of water.

H (With looks of astonishment). Why, mamma, it is broken!

M Not so (withdraws the pencil); there! it is straight again.

H Well, how strange!

M Another bit of natural magic, Harry.

H I shall not be able to trust my own eyes soon, I think.

M You must accustom yourself to take philosophic views of the natural world, and make all due allowance for optical illusions; seeing is believing this time, is it not?

H It is indeed, mamma; but explain all this.

M The explanation is very simple when once you get accustomed to view the phenomenon in its true light; refraction is neither more nor less than rays of light diverted out of their usual course by passing through a denser medium.

L I think I understand; the light comes straight through the air till it comes in contact with the water, and then the rays are broken.

M Just so; the giant of the Hartz Mountains, the rainbow, the twilight, and the various other phenomena are all due to the same cause, namely, refraction. In the case of the Giant of the Hartz Mountains, the sun had probably sunk eighteen degrees below the horizon, and though the traveller had lost sight of him, his rays being refracted by the density of the atmosphere which surrounds the earth, were diverted out of their course, and spreading on all sides, caused a gigantic shadow to rest on the mountain.

L That's it. The traveller perceived that shadow to be his own, and so was not frightened like the simple natives.

M The triumph of knowledge over ignorance. The higher the latitude, that is, the further removed from the equator, the greater the obliquity of the earth; the more slanting the sun's rays come to us, the greater the refraction; the greater the refraction, the greater the shadows, and consequently the longer the twilight; but there is another power contingent, and that is reflection: the rays are preserved from making their escape by the power of refraction, but they come to us by reflection.

H Now you are giving me two ideas to work out.

M I think I can exemplify both in the rainbow. You are convinced that this pencil is in reality straight, though at this moment it looks anything but straight, not that it can be called crooked either; it does not form a curve like the unhappy little bow legs we saw this morning, where nature had been diverted out of her course by want of a mother's care. The pencil is straight enough till it comes in contact with the water, and even then it would be straight but for the dip. It breaks at the point of contact on entering another medium, and that break forms ——

K An angle.

M Now you are coming to a correct idea of the motion of light, which comes to us in straight lines, and like the earth with the centrifugal power at work, would go on for ever in straight lines; but that on coming in contact with a denser medium, the rays instantly become diverted from their original course, and shoot off in a new direction: on passing out of that medium they again diverge into other lines—from air to water, from water back to air. All this will help to illustrate the phenomenon of the rainbow, which is always opposite the sun, and is caused by his rays passing through the drops of rain that linger in the atmosphere; the rays of light enter the drops of rain and instantly become absorbed and refracted, thus they pass through the drops, then out again slanting off in a new direction; each ray is twice broken, once on entering, and again on leaving the drop, so that light is twice refracted, and once reflected, before it comes to us. Every eye sees its own rainbow, arrayed in all the prismatic colours. The same effect may be observed in the glass of the crystal chandeliers; glass, though transparent, is a denser medium than water, and a good conductor, as it enables us to exclude the air whilst we admit the light into our dwellings. Do you never consider, Harry, before you rise in the morning how many thousand heads and hands have been employed to contribute to your wants and necessities, your comforts and enjoyments through the day? It may help to engage your attention to dwell on the blessings you enjoy, and the amount of patient industry required to produce them; the curtain you undraw, the window you look through, the carpet you step on, the clothes you wear, the porcelain from which you sip your coffee, the ships that came laden with merchandise and brought the sugar with which to sweeten it, the pastures that fed the cattle, the grain, the bread, the milk, the meat, and the elegancies and delicacies, any one of which would be a loss if wanting, some more to be deplored than others.

L I do not know that I have ever thought much of these things, but I should like to know more about them.

M I wish you to dwell on the useful, and must try and make you better acquainted with our arts and manufactures: you will then perceive the use of science.

L I can read, mamma.

M But will you?

L Yes, mamma, if you will tell me who invented reading and books?

M Printing you mean; Caxton was the

first English printer; he lived in the time of Edward IV.; but printing, like every other glorious invention, met with great opposition. It is to the introduction of printing that we owe pretty well all our knowledge.

L Do you think if I were to invent anything new, that I should be opposed?

M I think it not at all improbable.

L Then why should I benefit others, if others are not to benefit me?

M Because you cannot do otherwise than follow the instincts God has given you: where there is a thirst for knowledge, new light flows in, and with this light, comes the desire to communicate the discovery, even at the risk of persecution. What should we be but for those glorious intellects that braved every danger, and whose discoveries contribute so much to our enjoyment? Did you know the lives of some of those great men who have left records of their deeds and sufferings on earth, your heart would glow with gratitude towards them; you would desire to take them for models, and find your reward in doing good, leaving it to posterity to perfect your work, and appreciate your labours. The greatest geniuses are oftentimes the least valued in their generation; for how should the lesser the greater comprehend? Do you not know that the light shineth in darkness, and the darkness comprehendeth it not?

I Yes, mamma, so I have read; but this reminds me of something!

M What is it?

I I have read that comets were winged messengers; can you tell me anything about them?

M I can give you a list of remarkable comets that have appeared from time to time; but what they are baffles me. A learned writer declares a comet to be a baby planet; he maintains that our planet was originally a comet,—that the luminous tail which in comets is always turned towards the sun, is merely a tube through which nourishment is conveyed from the parent source. When the babe waxes strong, and is able to go alone, the tube, or feeding bottle, is withdrawn, and the baby comet takes its position with other planets. I will not vouch for the accuracy of this bit of natural history on comets; certain it is, that their movements are very rapid, and very eccentric, but in one respect they obey the beautiful laws of order laid down by our all-wise Creator. Whatever their mission, or their destiny, they never clash with other visitants or residents in the solar system. Their progress among the fixed stars is calculated with accuracy by astronomers, and their return is as certain to occur at the time predicted as if they were birds of passage.

K How wonderful to be able to predict the return of a comet!—how is this done, mamma?

M By means of conic sections.

K Ah! it is too wonderful for me!

M At present it is, no doubt; we must creep, dear child, before we can walk.

I Mamma, as this is our last evening, and I have a great wish to study astronomy, will you tell me why the celestial globe is covered with lions, bears, and all sorts of strange animals; and I want to know what a dragon is?

M First, let us dispose of the dragon, which is a large winged serpent, or fabulous animal, for no dragon ever existed, though we have the legend of St. George and the Dragon, in which St. George, the patron saint of England, is represented as transfixing the dragon with his spear; but all this belongs to the region of poetry and fable, in which the early chapters of every history abound.

I How hard it is when one wants truth, to get only fables.

M There is much truth contained in these said fables, and all eastern nations indulged in allegories; it was thus the ancients taught their children in days when the earth was in its childhood, and the light of truth was supposed to be too strong for beginners. Have you any fault to find with Æsop's fables, or those of La Fontaine?

K. Oh, no, mamma, I quite understand them; besides, the meaning is explained at the end.

M. The meaning is obvious throughout to persons of intelligence; but I can quite see that you may well be puzzled with regard to the constellations—why the seven stars, for instance, should be called the Great Bear, where no resemblance to any animal exists. Those stars more nearly resemble a plough, and on that account have been called Charles's Wain. The heavens were divided into clusters of stars by the old Egyptians, and as the names they gave to those stars do not impede our scientific knowledge, so we retain them; indeed, in some respects, they rather help us by means of the mythology. There are only fifteen stars of the first magnitude in our hemisphere, and these are easily distinguished with a little assistance; and the smaller stars, which are like diamond dust, may be filled in afterwards.

H How did you find out which was which?

M Well, Harry, I confess I had some trouble at first. I had been taught what in the schools is called "the use of the globes;" but when I endeavoured to apply my knowledge to practical purposes, I found the use of the celestial globe was to mislead me.

H How was that? Does not the celestial globe represent the heavens?

M How can it, when the globe is convex, whilst the heavens are concave?

H What is that?

M Think for a moment: your eye is convex, because it is prominent, but the space in which it is set is concave.

H Now I understand.

M Did you ever observe your face on the two sides of a spoon; the one side convex, the other concave?

L Yes; but neither side my likeness, I hope.

M The same may be said of the celestial globe with reference to the heavens. If I wanted a star, I looked for it in accordance with the latitude and longitude, and got the right ascension, as it is termed, for stars are not counted east and west, but all the way round from the point, Aries. But when I had got the star, say a bright red star in Taurus, called Aldebaran, or the Pleiads, a cluster in the same constellation, I found that Taurus, which is to the right of Aries on the globe, is to the left of Aries in the heavens, so that my evening studies did not tally with those of the morning. The convex globe gave just such a likeness of the concave heavens as the spoon does of your face, thus you may remember *my pointing* out to you a star of the first magnitude, called Arcturus, nearer the horizon than the Great Bear?

L I quite remember it.

M Can you also remember whether Arcturus was to the right or the left of the Great Bear?

L Yes, mamma, I have it all like a map before my eyes, with Arcturus to the left hand.

M Now let us refer to the celestial globe for Bootes and the Bear—(turns to the globe). Here they are. I must tell you that Arcturus is a star of the first magnitude in the constellation Bootes; the latter was probably a hunter, as he holds by the hand in a leash two dogs, called Canes Venatici (the Venetian dogs). Bootes was probably when on earth a mighty hunter, and by a species of hero worship was translated to the heavens after death, a distinction frequently accorded the illustrious dead; they are thus immortalized—embalmed in the memory.

K Now I see why they turned them into constellations.

M Their names have been thus handed down to posterity, and their deeds, like those of Hercules and others, were said and sung in days when books were unknown, ere the letters of the alphabet were invented.

K (Refers to the globe.) But what is this?

M It is the star we are speaking of, Arcturus.

K Well, I declare, it is on the right of the Great Bear, and I saw it with my own eyes on the left. Tell me how you learnt astronomy.

M By rather a tedious process. The celestial globe in one sense is right, that is, as right as its form will admit of, but you must imagine yourself an inhabitant of this eighteen-inch globe—you must put your head in and fancy you see the stars through holes in the roof.

K I shall never be able to get my head into that globe, or the stars into my head, so you must teach me.

M The way in which I learned was by making my own maps. I represented the heavens as I saw them, taking care to put the various stars into their latitudes and longitudes, and making them preserve their relative positions, so that I knew them by sight again in the heavens after seeing them mapped before me: to reason on the subject only taxed my faith, but did not assist me in the least.

H I should think so; but what labour! Why, you became a sort of Mrs. Hercules!

M Yes, Harry; but I did not think much of trouble in those days with an object to gain, and I was so happy the while.

H And so am I while I listen. But what became of the maps?

M I no longer remember. I frequently lent them to persons who knew little or nothing of astronomy, but were struck with the ingenuity of these diagrams. On one occasion they were omitted to be returned, and now I fear they are lost to me for ever. I can teach you the principal stars, however, and you can fill in the others by degrees from observation: or you can adopt my plan by making your own maps as you advance in astronomy; but you must make a voyage if you wish to see every star that shines.

K Cannot we see every star? Why is that?

M Because we live in an oblique sphere. See! I have raised the north pole 51½ degrees above the horizon, in accordance with the latitude of London. The polar star accords with the pole of our earth, whilst the Great Bear, Draco, Cassiopeia, Cepheus, and all those stars which revolve around the polar star, within 51½ degrees of latitude, never set,—that is, never go below the horizon, but roll on day and night, and year by year, without ceasing, always visible to us, but always invisible to the inhabitants of our antipodes. In the same way they have constellations which we cannot see; the Southern Cross is one of them. Should you ever make a voyage to the Cape of Good Hope, India, Australia, or South America, you will have the advantage of crossing the line, as the equator is termed, and of seeing every star in the heavens.

Ed. I do not understand why that is so.

Ma. I have placed the globe in the position you will then occupy; the poles of the ecliptic being in the horizon, you will see every star north and south. The polar star will no longer be vertical, but will correspond with the pole of the earth, whilst the zodiac, with its twelve signs, will roll over your head. We must now close our conversations for the present with this glorious prospect before our eyes. I cannot part from you whilst you remain a little boy but for a few hours at a time, and now the time has come when we must separate, for it grows late, and we have had a long evening.

Ed. And a very delightful one; thank you, dear mamma. I would not mind being a little boy all my life if I could have you to talk to me.

M You will think differently some day, when all the problems are worked out.

H I shall always love you, mamma, and always be grateful.

M I hope so, Harry, and I do not for a moment doubt it; now let us say good night.

(Harry embraces his mamma, and retires.)

THE END.

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